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SURGICAL TREATMENT OF INTUSSUSCEPTION.

INTUSSUSCEPTION of the bowels is an accident which gives rise to a well-recognized mechanical form of intestinal obstruction, which, like hernia and internal strangulation, should be subjected to early surgical treatment. Early recognition of the existence of invagination is therefore of the greatest importance for successful treatment, as the prospects for successful reduction by ordinary surgical means diminish with the development of secondary pathological conditions at the seat of invagination. Many of the artificial invaginations which I made in animals were reduced spontaneously within a few hours, and in order to study the effects of invagination I had finally to resort to suturing at the neck of the intussusciens in order to permanently retain the invaginated portion. Reduction was resisted after a time either by the swollen œdematous intussusceptum, or by the adhesions at the neck of the intussusciens, or between the serous surfaces throughout the invaginated portion of the bowel. From these observations

I have come to the conclusion that reduction by gentle but efficient distention of the bowel below the invagination would succeed in the majority of cases if this procedure were practised before either of the two principal conditions which cause irreducibility have had time to make their appearance.

Medical and Dietetic Treatment.—A strict attention to diet and avoidance of cathartics are important elements in the early treatment of invagination in limiting the invaginating process. After invagination has occurred further descent of the bowel is effected by the increased peristalsis caused by the partial obstruction. If the stomach is distended with food, a salt-water or mustard emetic should be given to empty this organ, after which the patient's diet should be limited to such articles of food as are digested and absorbed by this viscus. If the obstruction has existed for some time and intestinal contents have reached the stomach, the fluid should be removed by using the siphon stomach-tube, after which the organ should be washed out with a mild antiseptic solution, as a one per cent. solution of boracic acid or a saturated aqueous solution of salicylic acid. The administration of cathartics of any kind and at any stage of the affection is to be strongly condemned, as the increased peristalsis following their use could

not but increase the invagination and aggravate the secondary pathological conditions. The main object of treatment from the beginning should be to place the whole gastro-intestinal canal in a condition approaching perfect physiological rest. In acute cases the stomach should be emptied as described and stomach feeding restricted to the use of beef tea, peptonized milk, koumiss, and other equally digestible articles of food. Rectal injections of infusions of belladonna, nicotiana, cicuta, and other narcotics, as recommended in text-books of only twenty years ago, are not only dangerous but absolutely useless in effecting reduction or modifying the intensity of symptoms. The internal use of opium was strongly recommended by De Haen, Heberden, Howship, Abercrombie, Schoulein, and others. This drug exercises no special curative effect, but places the intestinal canal, and particularly the affected segment, in a condition most favorable to arrest further invagination; and should spontaneous reduction or disinvagination by surgical interference not be accomplished, the affected part is placed in a condition most favorable for a spontaneous cure by sloughing and elimination of the intussusceptum. The opiate should be given in small and frequently repeated doses until the desired effect—the arrest of the violent peristalsis

—is accomplished. With the appearance of peritonitis, the doses of opium must be increased to subdue the intense pain. If signs of exhaustion become apparent, the use of stimulants is indicated. Champagne, cognac, whiskey, and subcutaneous injection of camphorated oil, are most serviceable in meeting this indication during the later stages of the disease.

Distension of the Colon.—As soon as the existence of an invagination is suspected, the large intestines should be emptied of their contents by the administration of a copious enema, the patient being placed in the knee-elbow position, as advised by Hegar. Forcible distension of the colon with warm water is recommended in nearly every text-book of surgery since first suggested by Hippocrates as a means of correcting the mechanical difficulties in ileo-cæcal, ileo-colic and colic invagination. Warren, Schillbach, and others, report successful cases treated by this method. It is generally advised that the patient should be held in the inverted position during the time the injection is made. Useful as this measure may prove under favorable circumstances in reducing an invagination below the ileo-cæcal valve, it should never even be attempted if the invagination is located above this point, as numerous experiments on animals have satisfied me that fluids cannot be forced

beyond the ileo-cæcal valve, if this is in a normal condition, without inflicting serious injury in the bowel below the obstruction. The following experiment among others will serve to illustrate the therapeutic value as well as the dangers which attend this method of reducing an invagination :

Experiment I.—Adult cat. Two inches of the ileum were invaginated into the colon and fixed by two fine silk sutures at the neck of the intussusciens. For two days after the invagination the stools were scanty and contained mucus and blood. On the third day the abdominal cavity was reopened by an incision along the outer border of the right rectus muscle, and the invaginated bowel drawn forward into the wound. No peritonitis. The invaginated segment was very vascular, and the neck of the intussusciens covered with plastic exudation. The sutures were removed and the rectum and colon distended with water for the purpose of effecting reduction. As soon as the colon had become thoroughly distended the adhesions gave way with an audible noise, and complete reduction followed in such a manner that the portion last invaginated was first reduced. After reduction had been accomplished, the injection was continued to test the competency of the ileo-cæcal valve. As soon as the cæcum

was well distended the fluid passed readily through the valve into the small intestine, showing that the valve had been rendered incompetent by the invagination. The force required to overcome the adhesions in the reduction of the invagination was sufficient to rupture the peritoneal coat of the colon in three different places, the rents always taking place parallel to the long axis of the bowel. The animal died on the following day with symptoms of diffuse peritonitis.

A number of years ago I had succeeded in reducing an ileo-cæcal invagination by this means of effecting reposition. The patient was a child, two years of age, which, without any apparent cause, was suddenly attacked with symptoms of intestinal obstruction nearly two days before. The symptoms during this time pointed to invagination. The stools were scanty, mucus tinged with blood, each passage preceded and attended by distressing tenesmus; occasional attacks of vomiting; tympanites slight. Rectal injections had been given which brought away the fæcal matter below the obstruction. A distinct sausage-shaped swelling could be felt in the region of the transverse colon, extending as far as the splenic flexure. While the child was held in an inverted position, warm water was injected into the rectum with an

ordinary Davidson's syringe. The ascending colon could be distinctly felt after distension, when suddenly in continuing the injection something was felt giving way, and the swelling disappeared quite suddenly. A normal passage from the bowels followed, and the child recovered without any further untoward symptoms. As will be shown further on, distension of the colon with water as a mechanical means of effecting disinvagination in its efficiency and safety is inferior to rectal insufflation of hydrogen gas or atmospheric air, and should be abandoned as a therapeutic measure in the treatment of invagination.

Manual and Instrumental Reposition.—As early as 1856 Kade succeeded in reducing a colic invagination in a woman by the introduction of the arm up to the elbow into the rectum and colon. This method of reposition would, of course, only be applicable in the treatment of adults and in invaginations within reach of the hand. The reduction of invagination by the use of an œsophageal sound, or, better, by a strong whalebone probe, the point protected by a sponge, should always be done with the greatest care and gentleness, for fear of inflicting an irreparable injury of the intestine damaged by secondary pathological conditions. It is said that Nyssen reduced successfully a low invagi-

nation by the use of an œsophageal tube. As in manual reduction, the use of such instrumental aids should be limited to invaginations in which the neck of the intussusciens can be reached in this manner, or as a preliminary effort in facilitating means by which complete reposition can be accomplished. For instance, in ileo-cæcal and colic invaginations, when the intussusceptum protrudes from the anus, a partial reduction by some such means is necessary before disinvagination can be completed by rectal inflation.

Rectal Insufflation of Hydrogen Gas.—Distension of the bowel below the obstruction with filtered air or hydrogen gas is the safest and most efficient means of reducing an invagination that has not been rendered irreducible by great swelling of the intussusceptum or inflammatory adhesions. This method of reduction is far superior to rectal injections of fluids in overcoming the resistance offered by the invaginated portion of bowel on account of the greater elasticity of the substances employed, which makes it possible to exert an equal degree of reduction force, minus the force required in forcing a column of fluid as far as the seat of invagination. I prefer to use hydrogen gas to atmospheric air, as this substance is not only aseptic, but possesses important inhibitory anti-

septic properties, qualities which would be of the greatest importance should the bowel be ruptured in an attempt at reduction. If atmospheric air is used, it should be filtered before it is injected. As gas can be readily forced beyond the ileo-cæcal valve, this method is applicable in the treatment of invagination in any portion of the intestinal canal; and as distension of the intestine below the seat of obstruction may prove successful in correcting the mechanical difficulties due to other causes, it should be resorted to both as a diagnostic and therapeutic measure in the beginning of all cases of intestinal obstruction in which a positive diagnosis of other forms of obstruction cannot be made without it. The *modus operandi* of this surgical resource can be most forcibly shown by the following experiment :

Experiment 2.—Large adult cat. Six inches of the ileum were invaginated into the colon. Frequent bloody discharges until the third day, when the abdomen was reopened and the neck of the intussusciens exposed to sight, so as to observe directly the mechanism of disinvagination by rectal insufflation of hydrogen gas. As soon as the colon was well distended, the adhesions at the neck of the intussusciens began to give way, and complete reduction followed under the continuous elastic pressure from below.

The abdominal wound was again closed and dressed in the usual manner. The animal recovered completely, and was killed twenty-four days after the first operation. Abdominal wound well united. In the ileo-cæcal region, numerous adhesions around the portion of bowel which had been invaginated and subsequently reduced. As the force necessary to rupture the adhesions and to reduce the bowel produced no injury of any kind to the intestine below and at the seat of invagination, this experiment would tend to prove that insufflation can be practised successfully in cases of invagination of several days' duration. This procedure should be employed as early as possible, in fact as soon as an invagination is suspected, as the results will be most satisfactory when it can be used before the invaginating process has been arrested by traction of mesentery, œdema, and inflammatory swelling of intussusceptum or plastic adhesions. I am almost convinced that its proper use within a few hours after the accident has occurred would be followed by almost uniform success, and at this stage would be attended by little or no risks. To rupture the peritoneal coat of a healthy intestine by inflation requires from eight to twelve pounds of pressure to the square inch, so that even an intestine weakened somewhat by the secondary lesions would not yield under a pres-

sure sufficient to reduce the invagination. Before the inflation is made, the bowel below the obstruction should be thoroughly emptied by a copious enema. The patient should be placed in such a position that will afford most room in the abdominal cavity. If the hips are elevated, or, still better, if the patient is inverted, the abdominal viscera will gravitate towards the chest and thus render the inflation of the bowel below the obstruction much more easy and efficient. Rectal insufflation of hydrogen gas in the reduction of an invagination should always be made under the influence of an anæsthetic, administered to the extent of complete muscular relaxation. The pressure upon the rubber balloon should be uninterrupted, and should never exceed what will produce two pounds to the square inch in the distended bowel. Disinvagination by this method is effected by two distinct forces. In the first place, the steady elastic pressure of the gas distends the bowel between the sheath and the returning cylinder of the intussusceptum, which makes traction upon the neck of the intussusciens, while the column of gas by its elastic pressure against the apex of the intussusceptum acts as a direct reduction force. In order to accomplish the desired mechanical effect in a most satisfactory manner, the inflation must be made slowly and

continuously, as when these precautions are observed there is less danger of rupturing the bowel than when rapid inflation is made under the same pressure, but with interruptions, and the object of the inflation is more surely realized. The return of the gas is prevented most effectually by an assistant pressing the margins of the anus against the rectal tube. A small gutta percha female syringe makes the best rectal tube. A sudden diminution of pressure always distinctly felt by the assistant who compresses the balloon indicates either that disinvagination has been effected, or that a rupture of the intestine has occurred. It is exceedingly important that the surgeon should satisfy himself of the existence of a rupture, if this accident has occurred. The best way to recognize this complication is to continue the inflation under a pressure of not more than a quarter to half a pound to the square inch. If the invagination has been reduced by the inflation, the intestine above it will become gradually distended by the gas and the tympanites takes place first over the middle of the abdomen and above the pubes, ascending gradually as the inflation is continued, the area of dullness remaining the same but being transferred higher up. If the intestine has given way the gas escapes into the peritoneal cavity, and the existence of the accident is

proved by the appearance of a uniform free tympanites with disappearance of liver dullness. In a recent case there is no danger of rupturing the bowel under a pressure of two pounds to the square inch ; and in cases where the tissue of the intestinal wall yields under this pressure, the pathological conditions are such that a laparotomy is the only proper remedy; and the occurrence of the accident renders the indication for the performance of the operation imperative, without adding materially to its danger.

The value of rectal insufflation of air or hydrogen gas is well shown by the following two cases which recently came under my observation:

Case I.—The first case was a child, two years of age, which had been quite ill for two days. The attack was sudden, attended by pain in the abdomen, occasional vomiting, slight distension of the abdomen, and tenesmus. Small quantities of fæcal matter came away with the injections that had been frequently given to correct the constipation. The tenesmus was usually followed by small mucous discharges tinged with blood. An elongated swelling could be plainly felt in the region of the transverse colon, and extending down to near that sigmoid flexure. A positive diagnosis of ileo-cæcal invagination was made. The child was placed at once under the influence of chloroform, and

while held in the inverted position air was inflated from a large rubber balloon. On carefully watching the effect of the inflation, it could be distinctly observed that the descending colon at first became very prominent, and after this the swelling was forced higher up and gradually became shorter, when suddenly the resistance was overcome, and air rushed through the ileo-cæcal opening into the lower coils of the small intestine. The child was now laid on its back and the abdomen was carefully examined, but no swelling could be found. The place previously dull on percussion, corresponding in location to the invagination, was now resonant, a positive proof that the invagination had been reduced. Within a few hours the child had a number of copious stools and made a speedy and permanent recovery.

Case 2.—An infant, six months old. The child had been perfectly well until six hours before it had been brought to me for examination and treatment. I found a colico-rectal invagination, the intussusceptum projecting from the anus at least six inches. It is evident that this extensive descent of the colon had taken place within six hours. The mucous membrane presented a swollen, oedematous and almost livid appearance. The tenesmus was constant and severe; the stools were frequent, but very scanty.

The child was at once taken to the hospital, where it was chloroformed, and being held in inverted position the prolapsed portion was pushed upward beyond the anus, after which the invagination was readily reduced in a few minutes by rectal insufflation of air. The invagination did not return, and the child remained in perfect health.

Colostomy.—Two indications for the formation of an artificial anus might arise in the treatment of colic invagination : (1) In acute cases, when the general symptoms are so grave as to positively contra-indicate a laparotomy. (2) In irreducible chronic cases, when the lower portion of the colon is invaginated into the upper part of the rectum, where it is impossible to make a resection through the rectum or establish an intestinal anastomosis by lateral apposition. According to the location of the invagination, the operation is made either in the right or left inguinal region; in the former instance the opening being made in the cæcum, and in the latter in the descending colon. After exclusion of the obstruction from the fæcal circulation by this procedure, the patient may not only go on to recovery, but the obstruction is occasionally removed later spontaneously by disinvagination or sloughing and elimination of the intussusceptum. Dubois ("Enterotomie Pratiquee in Ex

tremis,"—*Journal de Med. de Bruxelles*, December, 1878) reports a case of colic intussusception where the invaginated portion could be felt in the region of the sigmoid flexure through the abdominal wall. Colostomy was performed above the seat of obstruction, and the patient not only recovered, but four months later the permeability of the intestinal canal was restored spontaneously, although the artificial opening had not closed.

Enterostomy.—The formation of an external intestinal fistula or enterostomy should only be resorted to in irreducible iliac, ileo-colic, and ileo-cæcal invagination when the patient is in such a collapsed condition that more radical measures are inadmissible. As in the majority of cases, the primary seat of invagination is at or below the ileo-cæcal valve; the artificial opening should be made in the right iliac region. Should the invagination be located higher up in the intestinal canal, and an empty collapsed coil of intestine present itself in the incision, it should be pushed aside and search made for a distended loop. An enterostomy is justifiable even when the patient is in an almost pulseless condition, as this operation is attended by little, if any, shock, as it could be done in a few minutes, and, if necessary, without an anæsthetic. Emptying the bowel above the seat of obstruction will

bring immediate relief by removing abdominal distension, and by favorably influencing the invaginated part by taking away the hydrostatic pressure above the obstruction, which in itself is a potent cause in maintaining vascular engorgement and inflammation. Langenbeck ("Verstellung eines Falles von Geheilter Enterotomie,"—*Verh. der Deutschen Gesellschaft für Chirurgie*, 1878) saved the life of a patient suffering from invagination of the colon by enterostomy. The invagination had advanced so far that the apex of the intussusceptum could be felt in the rectum. He performed Nelaton's operation and the patient recovered. Nine months after the operation both the invagination and the artificial intestinal fistula remained. The intestinal fistula in such cases is only made to meet the urgent symptoms caused by the obstruction, and if the patient survives the operation and the invagination is not removed spontaneously subsequently is to be followed by radical measures with the intention of restoring the continuity of the intestinal canal at the seat of obstruction by reducing the invagination, enterectomy, or intestinal anastomosis.

Laparotomy.—Remembering that the general mortality of invagination is seventy per cent., and in children less than eleven years of age spontaneous cure by sloughing and elimination

of intussusceptum does not exceed twelve per cent., it becomes plain that in cases where reduction is not accomplished by rectal insufflation, as described above, a laparotomy is indicated in all instances where the general condition of the patient is such as to justify such a procedure. There is absolutely no excuse in postponing the operation, as every hour adds to the exhaustion of the patient from the obstruction and adds new dangers, arising from the complications, which are surely to develop at the seat of obstruction. A radical operation undertaken at a time when the pulse is in a fair condition and before septic inflammation has reached the peritoneal cavity holds out a fair prospect of a satisfactory result. It is true that the experience of the past in the operative treatment of invagination is not such as to inspire confidence, but it must not be forgotten that almost without exception the abdomen was opened as a last resort, after the patient had become completely prostrated by the disease, or after the invagination had given rise to irreparable local conditions. Instead of discouraging operative interference, the statistics collected so far are the strongest possible arguments in favor of early operative interference where simpler measures, faithfully carried out, have failed.

Ashhurst ("Laparotomy for Intussusception,"

—*American Journal Medical Sciences*, July, 1874, p. 48) brought together, with more or less detail, the histories of thirteen cases in which laparotomy had been undertaken for the relief of intussusception. Of this number, five recovered and eight died. As the result of a careful study of his cases, he has come to the conclusion that the operation is not admissible in patients less than one year of age, as all operations up to that time done in children less than a year of age proved fatal. He also advises against an operation when the symptoms present, and particularly the existence of intestinal hemorrhage, render it probable that the tightness of the intussusceptum will lead to sloughing of the invaginated portion, as he claims that under these circumstances an operation would almost surely fail, while there is a fair hope that separation of the invaginated mass might lead to spontaneous recovery. Against the special contra-indications of the operation advanced here, it can be said that experience has abundantly shown that cure by spontaneous elimination of the intussusceptum seldom, if ever, takes place in very young children and infants; consequently, the hopelessness of the situation in such cases, where legitimate efforts at reduction have failed, can be advanced as the most logical argument in favor of operative

treatment, as the patient and surgeon have nothing to lose and everything to gain. Knaggs (*The Lancet*, June 4th, 11th, 1887), after reporting an unsuccessful case of abdominal section for invagination that occurred in his own practice, gives the results of thirty-seven operations, including his own. Of this number, eight recovered and twenty-nine died. In many of these cases peritonitis had set in before the operation was performed, and this condition and not the operation was answerable for the subsequent fatal issue.

Sands (*New York Medical Journal*, June, 1887) has tabulated the records of twenty-one cases of laparotomy for intussusception, eight of which have occurred since the publication of Ashhurst's paper. Of twenty cases in which the result of the operation is given seven recovered, and thirteen proved fatal, thus showing a mortality of sixty-five per cent. After a study of these cases, he came to the conclusion that the prognosis after operation is also influenced by the age of the patient; thus, of twelve cases of patients two years old or under, three recovered and nine died; of seven cases sixteen years old or over, four recovered and three died; showing that the mortality of the operation, as would be expected, is greater in infants than in adults. Sands remarks very properly show that

the mortality depends more on the condition of the intestine than the age of the patient. In taking all cases together, he has found that the mortality of the operation is fourteen per cent. in the easy, and ninety-one per cent. in the difficult cases.

Braun (*Verh. der Deutschen Gesellschaft f. Chirurgie*, 1885) tabulated fifty-one operations performed since 1870 ; that is, operations done under antiseptic precautions. Of this number, eleven were cured and forty died. In twenty-seven of these cases disinvagination was effected, and in twenty-four it was not ; of the former, eighteen were children and nine adults. Four children recovered, while fourteen died. Seven adults lived and two died. Resection of the invaginated portion was practised twelve times with only one recovery. An artificial anus was established in nine cases, followed by death in every instance.

The largest number of operations for invagination has been collected by Treves (*The Lancet*, December 13th, 1884). He gives the general mortality in one hundred and thirty-three recorded cases as seventy-two per cent.; where reduction was easy it was thirty per cent., and when difficult ninety-one per cent. No one can look over these tables without noticing that the mortality was greatly influenced by the time

which had elapsed since the invagination occurred and the local conditions of the parts involved, as when reduction was easy the results were much more favorable. This fact alone should convince us that laparotomy should be resorted to without delay as soon as a faithful attempt at reduction by rectal insufflation has demonstrated that reduction cannot be accomplished in any other way. The operation should be done as a first, and not as a last, resort.

As in cases of strangulated hernia, the obstacles to reduction become more serious and persistent as time advances, and the danger is augmented in proportion to the time which elapses until reduction is attempted. In reference to the time when the operation should be done, I can only caution against delay and make at the same time the positive statement that as in cases of strangulated hernia it should be done as soon as it has been shown that reduction is impossible by the employment of simpler measures. The age of the patient should not enter into consideration in deciding upon the propriety of an operation. Sands (*Op. cit.*) operated successfully upon an infant only six months old, where the ordinary treatment by injection and insufflation had been only partially effected in accomplishing disinvagination. The cæcum and appendix vermiformis and a small

portion of ileum remained firmly fixed in the sheath, and it required considerable traction force to release them.

Godlee (*The Lancet*, December 16th, 1882) performed abdominal section successfully for invagination in a child nine months old, four days after the commencement of acute symptoms. In this case the invagination had progressed so far that the apex of the intussusceptum protruded at the anus.

Mr. Hutchinson (*Medical Times and Gazette*, November 29th, 1883) narrates the particulars of a successful abdominal section for intussusception in a child two years of age. The invagination had commenced in the ileo-cæcal region, and during the course of one month had advanced so far that the distal end of the intussusceptum was extracted several inches at the child's anus. As rectal injections failed in reducing the bowel, the abdomen was opened by a median incision below the umbilicus, and the intussusception was then easily found and as easily reduced. The child made a rapid recovery.

Preparations for Operation.—Instruments, ligature and suture materials should be on hand to make a resection or an intestinal anastomosis, should it be found, inexpedient or impossible to reduce the invagination. As the operation

should follow immediately after an unsuccessful attempt at disinvagination, it is advisable to make the necessary preparations for the operation before the insufflation is made, so as to lose no unnecessary time and complete what is to be done while the patient is under the influence of the anæsthetic. As rectal inflation may become necessary to assist the reduction by taxis, the necessary apparatus should be on hand and ready for use. Several sizes of decalcified perforated bone plates must be on hand for making an intestinal anastomosis, should this become necessary. A large quantity of hot sterilized water, aseptic sponges and aseptic gauze compresses must be provided for, and the necessary stimulants for inhalation and subcutaneous use should be within easy reach, and be used promptly should shock threaten life during a prolonged operation. Should it become necessary to operate in a private house during the night, a good petroleum lamp or a number of tallow candles will furnish the requisite light.

Incision.—As a rule, to which there should be no exception, the incision should be made in the median line, as it furnishes the most ready access to the invagination, and enables the operator to apply the various surgical resources with the greatest facility. For special indications, a lateral incision may become necessary

during the course of the operation. If the swelling has not been previously located by palpation or insufflation, it is usually not difficult to find the invagination after the abdomen has been opened. As soon as the invaginated part has been found, it should be brought into or as near to the wound as possible for careful examination, as the subsequent action of the surgeon will be guided by the local conditions of the invaginated segment.

Disinvagination.—This should always be attempted if, on examination, the neck of the intussusciens and the external cylinder show no evidences of gangrene. The pathological conditions which resist reduction and which must be overcome have already been pointed out. In recent, and especially very acute cases, the œdematous swollen intussusceptum offers the greatest resistance. The same measures should be resorted to to enable reduction, as in the preliminary treatment of a phimosis or paraphimosis. *The œdema and inflammation swelling should be removed before any efforts at reduction are made.* This can be readily accomplished by steady, uninterrupted manual compression of the invaginated portion. Instead of making direct manual compression, it is better to surround the affected segment of bowel with a large flat sponge and make the pressure over this,

which will secure a more equal and uniform effect. Prolonged compression also results in an arrest of peristaltic action in the intussusci-
piens, which also favorably influences the disinvagination. As soon as the swelling has been reduced in this manner, reduction is attempted by making gentle traction upon the bowel above the neck of the intussusci-
piens while counter-traction is made upon the sheath just below the apex of the intussusceptum. The sheath and middle cylinder are often thrown in folds which, by making only traction upon the entering portion of the intussusceptum, are increased and become a serious difficulty in the way of reduction. The traction upon the sheath at the point designated prevents this folding and materially facilitates the process of disinvagination. The hand that makes counter-traction should be used at the same time in making pressure against the apex of the intussusceptum ; this can be done most effectually by stretching the sheath over it, thus bringing into harmony two reduction forces at each end of the affected segment of bowel, aiding each other in effecting disinvagination. Should these different methods of taxis produce no effect, inflation is practised; and as soon as the bowel between the returning cylinder and the sheath has become expanded, the efforts are repeated. The utility of combining inflation

with taxis in the reduction of an invagination which had resisted the usual methods became apparent to me in the following case, which came under my observation only a few weeks ago.

The patient was a child nineteen months old. Symptoms of obstruction had developed suddenly three weeks before the child was admitted into Milwaukee Hospital for operative treatment. The obstruction never became complete and at no time was the vomiting distressing. Discharges from the bowels frequent, of a sero-mucous nature, and often stained with blood. Tenesmus not constant, but at times quite severe. Copious injections had been used frequently, but with no effect either in procuring an alvine evacuation or in effecting reduction. At the time the patient was brought into the hospital, the abdomen was slightly tympanitic, a sausage-shaped swelling could be distinctly felt in the region of the transverse colon; face of a deathly pallor, and pulse almost imperceptible; temperature, subnormal. The diagnosis of invagination was plain, but I was somewhat in doubt whether at this stage it would be prudent to make an attempt at reduction by rectal insufflation. As it was evidently a case of ileo-cæcal invagination, I decided to give this latter procedure a faithful trial; and in case it should

not succeed, follow it at once by laparotomy. The child was placed under the influence of chloroform, and while held in an inverted position the insufflation was made by using a large rubber balloon for this purpose. Only a limited quantity of air could be injected, which had the effect of dilating the descending colon, and, at the same time, apparently reduced the length of the intussusceptum. I did not use the amount of pressure I would in a recent case, as I feared that the disease, which had existed for three weeks, had resulted in textural changes of the intussusciens which might have resulted in such weakening of the intestinal wall as to yield under a comparatively safe degree of pressure. After making a gentle but prolonged attempt with this method of reduction and not finding any evidences that unfolding at the neck of the intussusciens was taking place, I opened the abdomen at the middle line between the umbilicus and pubes, and had no difficulty in at once finding the invagination. The cæcum and ascending colon with the lower end of the ileum had become invaginated into the transverse and descending colon. The apex of the intussusceptum could be distinctly felt above the sigmoid flexure. The parts were greatly swollen, and were at once subjected to firm manual compression, which had a decided effect in reducing the

swelling. Traction was then made in the manner described above, but had no effect in starting the disinvagination. Inflation was now made and it could be distinctly seen that the space between the returning cylinder of the intussusceptum and the sheath became distended, and the same manipulations repeated, assisted by the elastic pressure, succeeded in forcing the intussusceptum in a backward direction, the adhesions between the serous surfaces giving way as reduction proceeded.

Examination of the bowel after reduction of the invagination showed two small rents of the peritoneum, one corresponding with the neck of the intussusciens and the other below this point; these were closed by a few Lembert sutures. The whole operation, including the insufflation, did not last more than an hour, and the child seemed to recover from the immediate effects in a satisfactory manner. Copious stools followed. Six hours after the operation the child laughed and played with a doll. Six hours later symptoms of collapse set in, and death followed within an hour. As no *post mortem* was made, it is somewhat difficult to explain the immediate cause of death. It must remain an open question whether the child died from delayed shock, septic peritonitis, embolism, or thrombosis of the pulmonary artery, If firm

adhesions about the neck of the intussusciens between the opposed serous surfaces of the two inner cylinders resist reduction, these should be carefully separated before traction is made. Rydygier suggests that this should be done by inserting the index finger. Any one who has had much experience with such cases must have observed that the neck of the intussusciens grasps the bowel very tightly, and that any such efforts as the introduction of a finger would be almost certain to result in a rupture of the bowel. If the treatment, as above directed, does not effect reduction, the presence of firm adhesions must be suspected. Rupture of the bowel has been frequently produced by using too much traction force in attempting reduction, and such an accident should always be avoided by handling the affected segment with the utmost care and gentleness, and by the careful removal of the causes which resist or retard the process of disinvagination. The adhesions should be separated by inserting between the serous surfaces a small, straight, blunt-pointed scissors, or, still better, a Kocher's director, passing it around the whole circumference between the inner and middle cylinders. When the adhesions have been separated, the efforts at reduction by traction and inflation are repeated. After reduction has been effected, the sheath and invaginated

portion are subjected to a careful examination. Small circumscribed patches of gangrene must be covered by stitching over them the peritoneum in a transverse direction to the long axis of the bowel with a few Lembert sutures. If the peritoneal coat has given way the rent is always longitudinal, and should be sutured in the same direction. Roser has suggested that before closing the external incision the affected segment of bowel should be sutured to the abdominal wall for the purpose of preventing reinvasion. Under proper after treatment it is not very likely that reinvasion will take place, and such method of fixation might subsequently result in another form of intestinal obstruction. The fear of recurrence of reinvasion is, however, not entirely unfounded, as Senator reports a case of colic invagination in which it occurred nine times in seventeen days. As a long mesentery is one of the anatomical conditions which permits an invagination to take place, and which favors its recurrence, shortening of this structure suggests itself as the simplest and safest procedure to prevent reinvasion. This can be done in a few minutes by folding upon itself the mesentery belonging to the affected segment of bowel, making the fold parallel to the bowel, and maintaining it by a few catgut sutures. Should repeated but

gentle attempts at reduction fail, one of two courses of treatment must then be pursued: (1) The establishment of an intestinal anastomosis (2) Resection of the invaginated portion with or without circular enterorrhaphy.

Intestinal Anastomosis.—An intestinal anastomosis between the bowel above and below the invagination by the use of decalcified perforated bone plates can be made in fifteen to twenty minutes, and at once restores the continuity of the intestinal canal. As soon as the hydrostatic pressure above the obstruction has been removed by this operation, the danger of gangrene is diminished, and the bowel may again become permeable by a subsequent spontaneous reduction or by sloughing and elimination of the intussusceptum. If the invagination remains permanently it does no particular harm, as the obstructed portion has been excluded permanently from the fecal circulation by the anastomosis and undergoes atrophic changes. I have in my possession a number of beautiful specimens of intestinal anastomosis from animals in which I had made an artificial invagination, and subsequently treated them by making an intestinal anastomosis, and I am firmly convinced that the same treatment is applicable in practice and promises good results in the future.

Koreynski ("Zwei Fälle von Darminvagination

langer Dauer," Virchow u. Hirsch's Jahresbericht, Bk. 11, 1881, p. 193) reports an exceedingly interesting case where a bimucous fistula was established spontaneously in a case of invagination, followed by a cure. The patient was forty-one years of age, and the symptoms of obstruction had lasted for six weeks, but were completely relieved by the anastomotic opening. The existence of such an opening could be readily verified by digital exploration of the rectum. After the symptoms of obstruction had subsided, the exclusion of a part of the intestinal tract could be ascertained by insufflation of the rectum, which at once produced a tympanitic distension of the colon. A similar but smaller communication was found on *post mortem* examination, as in the case reported by Gerry, previously referred to. Intestinal anastomosis, without resection of the intussusceptum is applicable only in cases of irreducible invagination in which the intussusceptum is only a few inches, at most a foot in length, and in which the external surface of the affected segment shows no indications of the existence of gangrene.

Enterectomy.—Resection of all of the cylinders, especially if the invagination is extensive, is a very grave undertaking, as it requires a long time for its execution, a matter of vital importance in these cases, and involves the removal of

important parts, and on these accounts should never be resorted to unless the intussusciens show unmistakable evidences of gangrene. The extent of the gangrene is immaterial in reference to the advisability of making a resection, as a small gangrenous spot necessarily would lead to perforation and death from septic peritonitis unless this radical measure is carried out. The resection under such circumstances must always include the entire intussusceptum, but not necessarily the entire sheath. The first evidences of gangrene upon the external surface of the bowel usually appear about the neck of the intussusciens. When the invagination is extensive, and the lower portion of the sheath presents a healthy appearance, it is only necessary to include so much of the extensive cylinder as to insure healthy tissue on the distal side. The sheath is divided by a circular incision below the point presenting evidences of gangrene, the intussusceptum is then drawn out and the entering cylinder divided above the neck of the intussusciens. The bowel above and below the invagination should be tied with a rubber band, passed through a slit made in the mesentery, to prevent fæcal extravasation during the operation. The mesentery corresponding to the section of bowel to be removed should be tied in small sections with fine silk ligatures, as tying

in larger sections or with catgut is liable to be followed by hemorrhage. After the resection has been made, it becomes a serious question how to proceed further. Shall the continuity of the intestinal canal be restored at once by suturing, or shall an artificial anus be established? When the resection involves the ileum above and the colon below, it is exceedingly difficult to restore the continuity of the intestinal canal by circular enterorrhaphy on account of the difference in the lumina of the ends to be united. As ileo-cæcal invagination is the most common form, it is evident that, as a rule, some other plan must be followed. Under these circumstances, one of two methods of procedure can be chosen.

Lateral Implantation.—The colon at the point of section is inverted to the extent of an inch or more, and permanently closed by making a few stitches of the continued suture, which should embrace only the structures down to the mucous membrane. This will maintain the invagination, and effectually prevents the escape of gas and fæcal extravasation, and the iliac or smaller end is implanted into a slit corresponding in size to the circumference of the bowel, made in the colon on the side opposite to the meso-colon, at a point about two inches below the closed end. Implantation and fixation are

most efficiently secured by lining the lower end of the ileum with a soft rubber ring and two inversion sutures of catgut, to which should be added, as a matter of safety, after the iliac end is in place, a superficial continued suture uniting the serous surface of the colon around the opening with the peritoneal coat of the implanted end.

Enterectomy, followed by Intestinal Anastomosis.—If lateral implantation cannot be readily done, an equally efficient method consists in closing both ends and establishing continuity of the intestinal canal by lateral apposition with decalcified perforated bone plates in the same manner as has been described under the head of intestinal anastomosis. Restoration of the continuity of the intestinal canal after resection for invagination by lateral implantation or lateral apposition requires much less time than a circular enterorrhaphy, while at the same time both operations secure better conditions for definitive healing than circular suturing, and on these accounts should, under these and similar circumstances, be preferred to the latter procedure. Circular resection also becomes necessary if the invagination has been caused by a malignant tumor, as is so often the case in chronic ileo-cæcal invagination in the adult. As the tumor always occupies the apex of the intussusceptum

the operation, to be described below, should be performed if the invagination is extensive and irreducible. If the invagination is limited, or can be reduced, circular resection of the invaginated portion, or of the segment to which the tumor is attached, is indicated. The following case I reported some time ago ("Two Cases of Resection of the Cæcum for Carcinoma, With Remarks on Intestinal Anastomosis in the Ileo-Cæcal Region," *Journal of the American Medical Association*, June 14th, 1890), and illustrates well the difficulties which are often encountered in the operative treatment of invagination caused by carcinoma in the ileo-cæcal region :

Carcinoma of ileo-cæcal valve with invagination ; Resection of cæcum with portion of colon ; Restoration of continuity of intestinal canal by ileo-colostomy with absorbable perforated bone plates ; Death six days after operation from peritonitis caused by deep ulcers of excluded portion of colon.—Patient was a corpulent married woman, 53 years of age, who was placed under my care at the Milwaukee Hospital, November 14th, 1889, by her physician, Dr. L. Reinhard. She is the mother of eleven children, and had always been in robust health until a year before she was admitted into the hospital. No history of tumors in any member of the family. Her

present illness dates back one year, when she was seized by an attack of vomiting without any apparent cause, as even then she was able to take food without causing any discomfort. The vomiting was not attended by nausea, and subsided after a few days without any special treatment. A month later a similar attack recurred, followed again by apparent complete recovery. During the next six months she suffered from similar attacks at intervals of one month, each attack lasting for a few days; between them the patient considered herself well. The intervals then became gradually shorter; at first every two weeks, then every week, and finally, every second or third day. During all this time she never suffered from constipation, the stools being normal in frequency and character. During the last ten months she has lost forty pounds in weight, and the complexion of the face, which formerly was ruddy, has now become pale and yellow. A tumor was discovered five weeks ago in the umbilical region by her attending physician. At that time she suffered a great deal from pain and vomiting, both of which were relieved by a brisk cathartic. From this time on the bowels moved several times a day, the discharge being liquid, but contained at no time either mucus or blood. A number of physicians who examined the patient since the tumor

was discovered in the umbilical region made a diagnosis of carcinoma of the stomach, and gave it as their opinion that the tumor involved the great curvature of this organ. Pain and vomiting have been the most prominent symptoms for a number of weeks, and were only partly relieved by subcutaneous injections of large doses of morphia. Although the patient felt more distressed after eating, the vomiting occurred at irregular intervals, and was not always brought on by taking food. A careful examination made the day before operation revealed the presence of a firm movable tumor, somewhat elongated in shape, and about the size of a medium-sized orange, a little above and to the right of the umbilicus. The tumor could be easily pushed under the costal arch on both sides, and in a downward direction on the right side nearly as far as the iliac region, but not quite as far to the left side. The mobility was less in a lateral direction. The patient was much emaciated and presented an anæmic, almost cachectic, appearance. It was almost the unanimous opinion of those who examined the patient at this time that the tumor, carcinomatous in character, was located in the large curvature of the stomach, but the possibility of carcinoma of the transverse colon was not excluded. The great mobility of the tumor induced me, at the

urgent request of the patient and her husband, to make an attempt to remove it in either event. The operation was performed November 14th, 1889. Immediately before the operation the stomach was washed out with a warm saturated aqueous solution of salicylic acid, and, at the same time, morphia and atropia were given subcutaneously. Chloroform was used as an anæsthetic. The abdomen was opened by an incision through the median line, extending from near the ensiform cartilage to the umbilicus. Manual exploration revealed the stomach in a healthy condition, and after careful examination it was ascertained that the tumor consisted of the structures of the ileo-cæcal region, which had become invaginated as far as the middle of the transverse colon. The incision was now enlarged in a downward direction for the purpose of securing more easy access to the seat of invagination. Moderate traction upon the bowel below the apex of the intussusceptum and above the neck of the intussusciens had no effect in reducing the invagination. I now grasped the invaginated portion with both of my hands, and firm compression for a few minutes was made for the purpose of diminishing the swelling by squeezing out the blood and œdema fluid, and thus facilitating the subsequent steps in effecting the invagination. The neck of the intussusciens

was dilated by inserting the tip of the index finger at different points. Traction was then made as before and reduction was accomplished, not, however, without making a number of longitudinal lacerations in the peritoneal covering of the intussusciens, the rents extending from its neck in an upward direction for two or three inches. The invaginated portion was eight inches in length, and was composed of the entire cæcum, a portion of the ascending colon, and a small part of the ileum. An examination of the surface of the intussusceptum showed that the obstacles to reduction were numerous adhesions between the opposed serous surfaces of the intussusceptum and intussusciens, which were forcibly separated during the disinvagination. On submitting the cæcum to a careful examination, it was evident that its interior was occupied by a tumor which appeared to involve the ileo-cæcal opening. The cæcum was therefore opened by a longitudinal incision, and examination of its interior by inspection and digital exploration revealed an ulcerating carcinoma, which occupied the entire ileo-cæcal valve, and had infiltrated a considerable portion of the cæcum. A similar incision was made into the ileum near its insertion into the cæcum, and digital examination through this opening proved that the carcinoma had diminished the size of

the ileo-cæcal opening to the diameter of an ordinary lead pencil. Retro-peritoneal and mesenteric glands normal. As the invaginated portion of the colon had been considerably damaged during the reduction of the invagination, it was decided to remove it with the carcinomatous cæcum. Fæcal extravasation was prevented in the same manner as in the preceding case by digital compression of the intestine beyond the line of section. The meso-colon and meso-cæcum were ligated in small sections with fine silk before the parts were excised. The ileum was divided about three inches above its insertion into the cæcum, and the colon about eight inches below the ileo-cæcal valve. Both resected ends were turned inwards about an inch, and the invagination maintained by a few stitches of the continued suture, which embraced only the serous and muscular coats, and one of them also the invaginated mesentery. The continuity of the bowel was restored by an ileo-colostomy, with decalcified perforated bone plates, in the same manner as in the first case, only that in this instance the incision into the colon was made about six inches from its closed end, as the part below this, which had been the intussusciens, could not be trusted in doing its share of the work in establishing the intestinal anastomosis on account of the pathological

conditions which were produced during the time the invagination existed. The peritoneal lacerations which were made during the reduction of the invagination were closed with a few superficial sutures. Scarification of the serous surfaces which were to be included by the plates was done before the approximation sutures were tied, and a number of superficial sutures were applied outside the borders of the plates to aid these in maintaining apposition between a maximum area of serous surfaces. Through the mesentery of the closed resected ends, a suture was passed which was brought out through a button-hole made for drainage in the right iliac fossa, and after the intestine was dropped into the abdominal cavity the approximated portion was drawn into proper position in the ileo-cæcal region by making traction on the suture, and was anchored in this locality by tying the suture over a small roll of iodoform gauze. A rubber drain was inserted through the button-hole, and the abdominal incision closed in the usual manner by two rows of sutures. External dressing was composed of a compress of iodoform gauze and a thick layer of absorbent cotton, which was retained by wide strips of rubber plaster encircling two-thirds of the circumference of the body. Duration of the operation, an hour and a half. The patient reacted well from

the immediate effects of the operation, and no untoward symptoms appeared until the end of the third day, when unmistakable symptoms of septic peritonitis developed suddenly, which rapidly increased in intensity as the inflammation became more diffuse. The dressings were now removed, and through the drainage opening pus was sought for, but no fluid could be found. Castor oil was given which procured free evacuation. The peritonitis proved fatal on the third day—six days after operation.

Post mortem four hours after death. Abdominal incision united throughout. Omentum displaced towards the right iliac region and adherent to intestines. Separation of the omental adhesions liberated about half a pint of sero-sanguinolent fluid from the right iliac region. A fibrino-plastic peritonitis, which had evidently started near the site of operation, was found to have become diffused from here over the lower portion of the peritoneal cavity, being especially well-marked in the right iliac region. Breaking down the adhesions the closed end of the colon was found turned in an upward direction, while the seat of approximation occupied the ileo-cæcal region. At a point corresponding to the cut surface of the meso-colon, a disintegrated softened blood clot was found. After removing the coaptated parts with adjacent portion of the

colon and ileum, the serous surfaces which had been included between the plates were found firmly adherent throughout, and the superficial sutures completely buried beneath a layer of plastic exudation. On connecting the ileum with a hydrant a large stream of water escaped from the gut end of the colon, showing that the new opening was fully established. On closing the open end of the colon the bowel was forcibly distended without causing any leakage, a positive proof that union between the coaptated surfaces was perfect. The remnants of the plates came away by the irrigation to which the specimen was submitted, the one from the ileum was much softened, while in that from the colon about three-quarters of the margin of the perforation was still intact. On splitting the bowel open on each side where the plates had been, the anastomotic communication could be seen from each side as an oval opening with smooth margins lined with mucous membrane, through which the thumb could be readily inserted as far as the first joint. The approximation sutures remained attached by one of the marginal threads. The most interesting condition was found in the excluded portion of the colon, that is, in that part below the anastomotic opening which formerly had been the intussusciens. An old circular ulcer about a quarter of an inch in diameter,

with abrupt indented margins, was found at a point which corresponded to the space between the two layers of peritoneum of the meso-colon. The ulcer had nearly perforated, and the peritoneum covering it was of an ashy-gray color, showing that it was on the verge of necrosis ; this point corresponded to the location of the softened blood clot, from where evidently the peritonitis had taken its origin. There can be but little doubt that infection occurred from the ulcer through the necrosed peritoneum, where it was communicated to the blood clot, and from there to the peritoneum. Another ulcer, somewhat smaller in size, was found about an inch higher up in the bowel, and at a point opposite to the attachment of the meso-colon.

In this case the carcinoma developed in the region of the ileo cæcal valve, where it infiltrated the entire circumference of the ileo-cæcal opening, thus giving rise to early stenosis and remote symptoms of intestinal obstruction. As the tumor in the umbilical region was only discovered five weeks prior to the operation, it is somewhat uncertain at what time invagination occurred. The great thickening of the wall of both the intussusceptum and the intussusciens, the great vascularity, and especially the numerous firm adhesions, would rather indicate that

the invagination had existed for a long time, perhaps six months or a year. The ileum for some distance was slightly dilated, and its walls hypertrophic. The thickening gradually increased as the ileum approached the cæcum. The ulcers which were found in the excluded portion of the colon, and which for obvious reasons I considered the direct cause of the fatal peritonitis, were undoubtedly of long standing, and were caused by the invagination. My only regret in this case is that I did not excise the entire invagination, intussusceptum, and intussusciens, as in case this had been done the patient would not only have recovered from the operation, but would in all probability have been permanently cured. In reference to diagnosis during life, I will repeat that the most urgent and prominent symptoms pointed rather to carcinoma of the stomach than to carcinoma of the cæcum, complicated by invagination. In the aged invagination is frequently caused by the presence of a malignant tumor in the bowel below the ileo-cæcal valve, and the obstruction, like in my case, is usually at first incomplete, and gives rise to a clinical picture suggestive of chronic stenosis.

The absence of blood and mucus in the discharges, of constipation and straining, and the presence of periodical attacks of vomiting, but

more especially the great mobility of the tumor, led me to suspect a carcinoma of the great curvature of the stomach rather than the conditions found during the operation. On the supposition that the tumor was located in the stomach, the abdomen was opened by a median incision, which, on being enlarged, afforded ample access to the parts which were to be treated by operative measures. Had the primary location of the carcinoma been known beforehand and the complication correctly interpreted, it would have been better to make a lateral incision. Adequate drainage, should this be required, can be established more readily after an operation through a lateral than a median incision in operations in the ileo caecal region.

In cases of colic invagination requiring an extensive resection, approximation of the two ends is not possible, on account of their distance from each other, and the comparatively slight immobility of this part of the intestine. In such a case lateral implantation is impracticable for the same reasons. The choice lies between the establishment of an artificial anus and lateral apposition; the former should never be made, as in case of recovery of the patient the faecal fistula would remain as a permanent condition without any prospects of a cure. The continuity of the intestinal canal can be restored at once in

these cases by making an ileo-colostomy or a colo-colostomy by lateral apposition with perforated decalcified bone plates, according to the location or extent of the resection.

Enterectomy and Circular Enterorrhaphy.—Wassiljew ("Invaginatio Ileo-cæcalis, Laparotomia, Resectio Intestini," Heilung, *Centralblatt f. Chirurgie*, No. 12, 1888) reports a very interesting case of resection for invagination and circular suturing which ultimately terminated in recovery. The patient was a man, aged twenty-five years, who was seized with abdominal pain and vomiting. As the symptoms of obstruction did not yield to ordinary treatment, laparotomy was performed on the second day. On opening the abdominal cavity, a swelling was readily detected in the right hypogastric region. This swelling was drawn forwards, and found to be an extensive invagination of the ileum into the colon. As reduction could not be accomplished, an elastic ligature was tied around the gut in two places and the ileum and mesentery were divided. Then the invaginated portion was readily withdrawn, and about seventeen inches were resected. The abdominal cavity was washed out with a weak solution of sublimate, and the cut ends of the gut were fixed by sutures to the abdominal wound. Much gas and faecal matter escaped when the ligatures were untied. During the

sixth week an operation was performed for the cure of the artificial anus. About six inches more of the intestine were resected, and the cut ends united by two rows of sutures. On the third day the bowels moved, but on the fifth day the faecal discharges again escaped through the wound. The different attempts to close the fistulous opening failed. Digital exploration showed that a spur was beginning to form. To this spur a pressure forceps was applied ; it fell off on the third day ; ultimately the fistula closed.

Enterectomy ; excision of Intussusceptum, followed by Intestinal Anastomosis.—As a last and distinctly separate class from invagination in reference to operative treatment are cases in which the invagination is extensive and irreducible, with no external evidences of gangrene. Resection of the entire segment is not to be thought of, as death from the immediate effects of the operation would be almost sure to follow. An anastomotic communication between the bowel above and below the obstruction would exclude too much of the intestine permanently from the faecal circulation, and in many cases it would be impossible or impracticable to make an operation of this kind. In preference to making a permanent artificial anus on the proximal side of the obstruction, I would suggest to

remove the intussusceptum through an incision below the neck of the intussusciens, this to be followed by an intestinal anastomosis, uniting the wound made with a similar wound in the bowel above the neck of the intussusciens, the whole operation consisting of three stages: (*a*) Enterotomy; (*b*) resection of intussusceptum, and (*c*) intestinal anastomosis.

The sheath is opened by longitudinal incision about two inches below the neck of the intussusciens on the free convex side of the bowel. This incision must be long enough to enable the extraction of the intussusceptum. A large aneurism needle, armed with a small rubber cord band or tubing, is passed around the intussusceptum, between it and the sheath. This rubber ligature is then tied with sufficient firmness to occlude completely the lumen of the inner cylinder of the intussusceptum, and to constrict the mesenteric vessels, to prevent hemorrhage after resection of the part below it. By making traction upon the ligature the intussusceptum is brought well forward into the incision, when the anterior half is divided about an inch below the ligature, with straight, blunt-pointed scissors, after which the artery needle is passed around it just below the point of section and the division completed between the ligature and the artery needle. As the external surface of the intussus-

ceptum, covered with mucous membrane, faces the mucous lining of the sheath, adhesions are never present between these structures in recent cases, and extraction of the resected portion of the inner two cylinders can be effected without much difficulty. The ligated stump is dropped into the lumen of the bowel and pushed upwards away from the incision. Disinvagination of the remaining portion of the intussusceptum is prevented by adhesions about the neck of the intussusciens and the rubber ligature, and in the absence of such, a few superficial sutures are applied at the neck of the intussusciens. The obstruction is now complete, but the obstructed segment of bowel is at once excluded from the faecal circulation by making an anastomotic opening between the bowel above and below it. If the incision made for the resection and removal of the intussusceptum is too large for this purpose, it is partly closed by suturing, after which it is united with a similar incision in the bowel, an inch or two above the neck of the intussusciens. The wounds are brought together and held in accurate apposition between two perforated decalcified bone plates, assisted by a number of superficial sutures along the margins of the plates. Complicated as this operation may appear, it is very simple, and can be done in a much shorter time than it would take to

make a circular resection, followed by circular suturing. The obstruction, made complete by the operation, is relieved at once completely and permanently by the anastomosis. The ligated portion of the intussusceptum will, of course, become gangrenous, from the elastic constriction, and will later come away with the ligature.

Excision of the Intussusceptum through the Rectum.—In cases of invagination of the colon into the rectum, with or without the presence of a tumor, the necessary operative procedure should be done through the rectum. If no tumor is attached to the apex of the intussusceptum, reduction is attempted by rectal insufflation, aided, if necessary, by insertion of the hand into the rectum in adults, and by the use of an œsophageal tube or a whalebone bougie, the end protected with a sponge, both in adults and children. If these means fail in reducing the invagination, the tumor, if it exists, or the intussusceptum, or both, can be removed through the rectum. The case of Kulenkampff, previously referred to, serves a good example in illustrating this part of the operative treatment of invagination. Bryant (*British Medical Journal*, April 9th, 1887) relates the case of a lady, aged seventy-five, who had been suffering from obstruction, due to a low invagination, for fourteen days. He suspected the existence of a

tumor, and this, after much difficulty, was found, drawn down, and removed ; the patient making a rapid and permanent recovery.

Barker (*The Lancet*, May 14th, 1887), in a case of invagination of the rectum, due to adenoid epithelioma of that part of the gut, succeeded in drawing down and excising the affected part, and reduced the invagination. The patient made a speedy, and what appeared a permanent, recovery. Three similar cases had been treated previously in the same manner, two by Verneuil, and one by Kulenkampff, only one of them recovering. The case reported by Nicolaysen ("Tumor Carcinomatosus Intestini," S. Romani; "Resektion of S. Romanum," Heltredelse; "Nord. Med. Arkive," Bk. xiv., No. 13) is of special interest as illustrating the course to be pursued when it becomes necessary to resect a portion of the intestine with the tumor. The patient was a woman, forty-nine years old, who had suffered from troublesome constipation and painful defecation for a year, due to chronic invagination of the sigmoid flexure of the colon into the rectum, produced by an epithelioma. Through the rectum a tumor could be felt, which, by traction, could be drawn down to the anus. The diagnosis made was carcinoma of the colon and invagination of colon into rectum. The patient could produce the invagination at

will. The extirpation was made by pulling the tumor downwards beyond the anal orifice. The healthy mucous surfaces 2.5, ctm. above the base of the tumor were circumscribed by a row of silk sutures, which were carried through the entire thickness of both intestinal walls. The tumor was excised one ctm. below the sutures ; only one artery had to be tied. Posteriorly and on the left of the circular wound the divided meso-colon could be seen. The wound was accurately united by a superficial continued suture. As soon as the bowel was replaced it retracted as far as the upper portion of the rectum. The patient had recovered after fifteen days, and reported herself well at the end of two and a half months. The intestinal tube removed measured 6.5 ctm. The tumor, under the microscope, showed the typical structure of cylindrical-celled epithelioma.

Mikulicz has devised and described a somewhat similar operation for such cases recently, and reports a successful case. The invagination was of a colico-rectal form ; the intussusceptum protruded some distance beyond the anus. He first divided the outer cylinder anteriorly and united the resected end with the inner tube by suturing. The same was then done posteriorly, and when the whole circumference was securely sutured, except at a point corresponding with the

mesenteric attachment, the vessels here were tied as fast as they were divided, after which the resection was completed, and finally the mucous membranes were united by a circular continued suture and the bowel returned.

Konig made the parts in a case of this kind more accessible by making an incision in the perineal raphe and extirpating the coccyx.

CONCLUSIONS.

1. Intussusception of the bowels is a strictly surgical affection, and should be treated as such from the beginning, on the same ground as a **strangulated hernia**.

2. Immediately after the accident has occurred peristaltic action should be arrested by emptying the stomach by an emetic or irrigation, by suspending stomach feeding, combined with the administration of opiates in sufficient doses to procure rest for the bowel at and above the seat of **invagination**.

3. Prompt arrest of peristalsis procures for the affected part the most favorable conditions to arrest further invagination and to effect **spontaneous or artificial reduction**.

4. Artificial means to effect disinvagination should be instituted as soon as this form of intestinal obstruction is recognized or even suspected.

5. Rectal insufflation of hydrogen gas or filtered air is the most efficient and safest procedure in reducing the invagination, and, if employed sufficiently early, will prove successful in the majority of cases.

6. Inversion of the patient and complete relaxation of the abdominal muscles by the use of an anæsthetic are important factors in rendering the inflation efficient.

7. Enterostomy and colostomy, according to the seat of the invagination, are only permissible if the patient's general condition does not warrant laparotomy.

8. Laparotomy in all other cases should be done as soon as the irreducibility of the invagination has been demonstrated by rectal insufflation.

9. In acute recent cases the swelling of the intussusceptum, caused by the circular constriction at the neck of the intussusciens, often proves a serious obstacle to reduction, and should be removed as nearly as possible by manual compression made direct or over a large aseptic sponge before attempts are made to reduce the invagination by traction.

10. Reduction of the invagination is accomplished most readily by making traction in opposite directions upon the bowel, above the neck of the intussusciens, and upon the sheath

below the apex of the intussusception, combined with pressure against the intussusceptum in a direction from below upwards.

11. If adhesions between the apposed serous surfaces of the inner two cylinders resist reduction, they should be carefully separated with a Kocher's director or a small pair of straight blunt-pointed scissors before traction is made.

12. After reduction has been accomplished the affected segment of the bowel should be carefully examined, and small patches of gangrene or rents of the peritoneal coat covered by stitching the peritoneum over them.

13. Recurrence of invagination is prevented most effectually by shortening the mesentery by folding it in the direction of the bowel, and fastening the fold in this position with a few catgut or fine silk sutures.

14. If the external surface of the bowel presents evidences of gangrene, disinvagination should not be attempted, and in such cases a resection is absolutely indicated.

15. The resection, under such circumstances, should always include the whole intussusceptum, but only so much of the intussusciens as is threatened by gangrene.

16. If the continuity of the bowel cannot be restored by circular suturing, either on account of the difference in size of the lumina of the

resected ends, or inflammatory softening, the same object is attained in an equally satisfactory manner, and more safely, by lateral implantation or intestinal anastomosis.

17. If the invagination is not extensive, but irreducible, and the bowel presents no signs of gangrene, the obstruction should be allowed to remain, and the continuity of the intestinal canal restored by making an anastomotic opening between the bowel above and below the invagination, by the use of perforated decalcified bone plates.

18. If the invagination is extensive, irreducible, and the bowel presents no indications of gangrene externally, the intussusceptum should be made accessible through an incision below the neck of the intussusciens and resected after securing the stump with an elastic ligature, after which the obstruction is permanently excluded by an intestinal anastomosis.

19. In irreducible colico-rectal invagination, or when this form of invagination has been caused by a malignant tumor, the intussusceptum should be drawn downward and removed by the operation devised by Mikulicz.

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